

**IN THE SPECIFICATION:**

The specification amendments are based upon double spaced application copy attached as Appendix A to this Reply. A copy of the amended specification is attached as Appendix B to this Reply.

Insert the following section headings on page 1 following the application title and before the paragraph beginning at line 3:

---

**B1**  
**BACKGROUND OF THE INVENTION**

**(1) Field Of The Invention**

Insert the following section heading on page 1 after the paragraph ending as line 5 and before the paragraph beginning on line 6:

---

**B2**  
**(2) Description Of The Art**

Insert the following section heading before on page 3 before the paragraph beginning on line 1:

---

**B3**  
**SUMMARY OF THE INVENTION**

Insert the following section heading at page 2 following the paragraph ending on line 20 and before the paragraph beginning on line 22:

---

**B4**  
**DESCRIPTION OF THE CURRENT EMBODIMENT**

Amend the paragraph at page 1, lines 8-16 as follows:

---

Micro air vehicles (MAVs) play a key role in military and surveillance operations. For these

**B5**

*B5*

MAVs, a range of engine characteristics is needed to meet specific requirements, such as low speed, low noise, high speed, etc. In this specification MAVs are defined as air vehicles which have a wingspan of 1 metre or less and/or a weight of 2kg or less. Features such as weight, ease of starting, reliability, etc. are important in the choice of the power plant. Air breathing engines or motors are usually attractive on weight grounds because they do not have to carry their own oxidant. However this may not be so important at small scales when the mass of the engine itself is relatively high. In addition, of course, small engines have relatively poor thermal and propulsive efficiency due to low cycle temperatures.

---

Amend the paragraph at page 1, lines 18-23 as follows:

*B6*

Hydrogen peroxide engines are known. The inventors have determined that these engines can be built small enough and give adequate performance requirements for use in MAVs. Hydrogen peroxide can nowadays be generated 'in the field' by electrolytic techniques. It can be decomposed catalytically to produce steam and oxygen at high temperature and is an acceptable propellant in its own right with a high specific thrust and a low infrared (IR) signature.

---

Amend the paragraph at page 2, lines 1-6 as follows:

*B1*

The invention comprises a micro air vehicle comprising a tank adapted to contain hydrogen peroxide and connected to a region adapted to decompose hydrogen peroxide, and a nozzle adapted to exit the decomposition products of hydrogen peroxide to provide thrust, means to provide a hydrocarbon fuel adapted to burn by consuming oxygen from the decomposition of hydrogen peroxide whereby the hydrogen peroxide is pressurised thus providing pressurised oxygen to pressurise said fuel engine comprising a source of hydrogen peroxide and a source of hydrocarbon fuel; a decomposition region for decomposition of hydrogen peroxide and a combustion region for combustion of hydrocarbon fuel with oxygen produced from such decomposition; and a nozzle to exit products of such decomposition and combustion..

---

Amend the paragraph at page 2, lines 8-10 as follows:

Further is provided a micro air vehicle equipped with such an engine and a method of propelling a micro air vehicle comprising the steps of decomposing hydrogen peroxide, combusting a hydrocarbon fuel with oxygen produced from such decomposition, and exiting the products of such decomposition products through a nozzle to provide thrust.

Delete the paragraph at page 2, lines 20-21 from the application without prejudice as follows:

~~Preferably a hydrocarbon fuel is provided to consume oxygen from the decomposition of hydrogen peroxide. Preferably pressurised oxygen is used to pressurise said fuel.~~

Amend the paragraph at page 2, lines 23-24 as follows:

The invention will now be described ~~with~~ by way of example only and with reference to the following figures of which:

Amend the paragraph at page 3, lines 3-4 as follows:

Figure 1 shows an embodiment of the invention comprising a decomposition and combustion chamber/nozzle and a ducted fan.

Amend the paragraph at page 3, lines 5-11 as follows:

In a simple embodiment of the invention, a MAV power plant 1 includes a fuel tank 2 containing 34g of H<sub>2</sub>O<sub>2</sub>. To hold this weight of fuel, the fuel tank can be a simple cylinder (2cm in diameter and 7.5cm in length). The fuel tank alone will weigh about 16g if it is made of aluminium and its thickness (1mm) should be sufficient to contain the pressure inside the tank. The fuel tank is connected to a decomposition and combustion chamber/nozzle 35 of weight less than 2g.

Amend the paragraph at page 3, lines 18-24 as follows:

A simple convergent/divergent nozzle is used in the flow parameter calculations necessary to diminish the combustion chamber pressure and nozzle exit area. A chamber pressure of 2.07bar (30psi) and a nozzle exit diameter of about 2mm will produce a mass flow through the nozzle of about 0.17g/s and an nozzle exit velocity of M 1.1. The thrust produced now is about 0.124N which is comparable to the amount required to propel an MAV. ~~A monopropellant ( $H_2O_2$ ) propulsion system has the advantages of low exhaust temperature and simple equipment design.~~

Amend the paragraph at page 4, lines 2-13 as follows:

In a preferred embodiment, a bipropellant system uses hydrocarbon fuel to consume the excess oxygen. This system uses an additional tank 3 to store the hydrocarbon. This has a clear advantage in endurance over ~~the~~ monopropellant system. However, the gain in endurance must weigh against the increase in combustion temperature and complexity in the fuel system. At temperatures in excess of 2400K, very few materials will be suitable for making the combustion chamber. Also, very efficient cooling techniques must be implemented to avoid damage to the combustion chamber. Preferably the propulsion system utilises hydrogen peroxide and kerosene as fuel and oxygen as the oxidant. A bipropellant ( $H_2O_2$  and kerosene) propulsion system has a 70% improvement on flight endurance but has high exhaust temperature (circa 2700K) which makes the design and selection of material for the combustion chamber/nozzle very challenging. A bipropellant system with on-board oxygen gives the best flight endurance.

Amend the paragraph starting at page 4 line 15 and ending on page 5, line 5 as follows:

In the most preferred embodiment the system comprises a bipropellant system as described above with the addition of a ducted fan. Such an arrangement is not known per se. Figure 1 ~~shows~~ is a figure showing the arrangement 4 of a hydrogen peroxide based ducted fan engine comprising a decomposition and combustion chamber/nozzle arrangement 5, and a turbofan 6 comprising turbine 7 and fan 8 arranged within a duct 9. In the ducted fan engine design, air passes ~~through~~around the outside of the decomposition and combustion chamber/nozzle. The front of

the decomposition and combustion chamber has to be shaped to avoid flow separation. The combustion chamber/nozzle 5 will attain very high temperatures during operation and the bypass flow will help to cool the nozzle. For a bypass ratio of 10, the duct exit flow velocity is found to be about 300m/s and the duct exit is 3mm in diameter. The fan rotational speed is estimated to be 1.63E6rpm. This is due to the small size of the fan. ~~While t~~These calculations are based on a nozzle throat area of 1mm diameter. The total thrust produced by this engine is 0.634N. ~~Preferably a~~ The hydrocarbon based fuel is also burnt within the decomposition and combustion chamber, at least in part using oxygen produced by the decomposition of hydrogen peroxide. ~~The hydrocarbon may be burnt in the region of the nozzle.~~

Please cancel the paragraph at page 5, lines 7-9 from the application without prejudice as follows:

~~Considerations have been given to the utilisation of an on-board oxygen cylinder as a pressure source for fuel delivery of oxygen (2.4g at 137.93bar) will increase the flight endurance by 2.7 minutes (0.38mm throat) storage tank of radius 1cm and length 3cm.~~